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Towards Node Cooperation in Mobile Opportunistic Networks

Abderrahmen Mtibaa
University of Missouri-St. Louis, amtibaa@umsl.edu

Khaled Harras

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Authors **Abderrahmen Mtibaa, Khaled Harras**
Institution Carnegie Mellon University in Qatar, Doha, Qatar
e mail hamouda@qu.edu.qa

Mobile devices such as smart-phones and tablets are becoming ubiquitous, with ever increasing communication capabilities. In situations where the necessary infrastructure is unavailable, costly, or overloaded, opportunistically connecting theses devices becomes a challenging area of research. Data is disseminated using nodes that store-carry-and-forward messages across the network. In such networks, node cooperation is fundamental for the message delivery process. Therefore, the lack of node cooperation (e.g., a node may refuse to act as a relay and settle for sending and receiving its own data) causes considerable degradation in the network. In order to ensure node cooperation in such networks, we investigate three main challenges: (i) ensuring fair resource utilization among participating mobile devices, (ii) enabling trustful communication between users, and (iii) guaranteeing scalable solutions for large number of devices.

(i) Fairness is particularly important for mobile opportunistic networks since it acts as a major incentive for node cooperation. We propose and evaluate FOG - a real-time distributed framework that ensures efficiency-fairness trade-off for users participating in the opportunistic network.

(ii) Since users may not accept to forward messages in opportunistic networks without incentives, we introduce a set of trust-based filters to provide the user with an option of choosing trustworthy nodes in coordination with personal preferences, location priorities, contextual information, or encounter-based keys.

(iii) Mobile opportunistic solutions should scale to large networks. Our hypothesis is that in large-scale networks, mobile-to-mobile communication has its limitations. We therefore introduce CAF, a Community Aware Forwarding framework, which can easily be integrated with most state-of-the-art algorithms, in order to improve their performance in large-scale networks. CAF uses social information to break down the network into sub-communities, and forward message within and across sub-communities.

In the three contributions we propose above, we adopt a real-trace driven approach to study, analyze, and validate our algorithms and frameworks. Our analysis is based on different mobility traces including the San Francisco taxi-cab trace, traces collected from conferences such as Infocom'06 and CoNext'07, and Dartmouth campus wireless data set.